9. <u>Sequence VID LTMS Requirements</u>

The following are the specific Sequence VID calibration test requirements.

A. <u>Reference Oils and Critical Parameters</u>

The critical parameters are Fuel Economy Improvement at 16 hours (FEI1) and Fuel Economy Improvement at 96 hours (FEI2). The reference oils required for test stand/engine calibration are reference oils accepted by the ASTM Sequence VI Surveillance Panel. The means and standard deviations for the current reference oils for each critical parameter are presented below.

FUEL ECONOMY IMPROVEMENT at 16 Hours
Unit of Measure: Percent

Reference Oil	Mean	Standard Deviation
540 (GF5A)	1.32	0.12
541 (GF5D)	0.87	0.12
542 (GF5X)	1.49	0.12

FUEL ECONOMY IMPROVEMENT at 100 Hours
Unit of Measure: Percent

Reference Oil	Mean	Standard Deviation
540 (GF5A)	1.04	0.14
541 (GF5D)	0.71	0.14
542 (GF5X)	0.80	0.14

B. <u>Acceptance Criteria</u>

1. New Test Stand/Engine

a. A minimum of three (3) operationally valid calibration tests (uninterrupted by non-reference oil tests), with no Shewhart severity alarms (all parameters), are required to calibrate each stand/engine. Precision requirements and severity adjustments are only to be evaluated after the third operationally valid test that has successfully met the Shewhart severity requirement. Note that Special K limits may not be used for Shewhart severity control charts in the calibration of a new stand/engine. Special K limits may only be used for existing stand/engines.

b. For every two (2) operationally invalid tests during the attempt to calibrate a new stand/engine after the first operationally valid test (the count does not start until after the first valid test), an additional operationally valid calibration test will be added to the stand/engine calibration requirement.

- Exceed EWMA stand/engine action limit for severity

  - First check the status of the precision alarms. Under certain circumstances, Special K may not be utilized.

  - Calculate stand/engine Severity Adjustment (SA) for each parameter that exceeds the action limit. Use the current laboratory EWMA (Z_i) as follows:

    FEI1: $SA = (-Z_i) \times (0.12)$
    FEI2: $SA = (-Z_i) \times (0.14)$

  - Confirm calculation with the TMC.

The following industry issues are handled by the TMC and do not require individual laboratory action.

- Exceed EWMA industry chart action limit

  - TMC to notify test developer, surveillance panel chairman, and ACC Monitoring Agency. Meeting of TMC, test developer, and surveillance panel required to determine course of action.

- Exceed EWMA industry chart warning limit

  - TMC to notify test developer, surveillance panel chairman, and ACC Monitoring Agency. Coordination of TMC, test developer, and surveillance panel chairman required to discuss potential problem.

5. Removal of Test Stand/Engines from the System

The laboratory must notify the TMC and the ACC Monitoring Agency when removing a stand/engine from the system. No reference oil data shall be removed from the control charts from test stand/engines that have been used for registered candidate oil testing. Reintroduction of a stand/engine into the system requires completion of new stand/engine acceptance requirements. In all instances of stand/engine removal, stand/engine renumbering can occur only if the stand/engine undergoes a significant rebuild, as agreed upon by the laboratory and the TMC.

29. High Temperature Cyclic Durability Test LTMS Requirements

The following are the specific High Temperature Cyclic Durability calibration test requirements.

A. Reference Oils and Critical Parameter

The critical parameter is Cycles to Unsychronized Shifts. The reference oils required for test stand and test laboratory calibration are the reference oils accepted by the ASTM High Temperature Cyclic Durability Test Surveillance Panel. The means and standard deviations for the current reference oils for the critical parameter are presented below.

CYCLES TO UNSYCHRONIZED SHIFTS
Unit of Measure: Cycles

Reference Oil	Mean	Standard Deviation
150-2	24271	4623
151-3	74489	9662
155	74489	9662

B. Acceptance Criteria

1. New Test Stand

- A minimum of seven (3) operationally valid calibration tests, with no stand Shewhart severity alarms, must be conducted. Two (2) tests must be conducted on reference oils 151 or 155 or subsequent approved reblends, and one (1) test must be conducted on reference oil 150 or subsequent approved reblends.

2. Existing Test Stand

- The test stand must have been TMC calibrated prior to LTMS introduction or previously accepted into the system by meeting LTMS calibration requirements.

- A test stand must complete one test on reference oil 151 or 155, or subsequent approved reblends, with no stand Shewhart severity alarm.

- Every other calibration sequence, a test stand must complete one test on reference oil 151 or 155, or subsequent approved reblends, and one test on reference oil 150, or subsequent approved reblends, with both tests having no stand Shewhart severity alarms.

Sequence VID Reference Oil Targets							
		Effective Dates		FEI1		FEI2	
Oil	n	From[1]	To[2]	$\overline{X}$	s^3	$\overline{X}$	s^3
540 (GF5A)	11[4]	12-29-08	12-2-09	1.32	0.14	1.04	0.16
540 (GF5A)	11[4]	12-3-09	***	1.32	0.12[5]	1.04	0.14[5]
GF5B	3[4]	12-29-08	***	0.97	0.14	0.63	0.16
GF5C	4[4]	12-29-08	***	1.24	0.14	0.59	0.16
541 (GF5D)	11[4]	12-29-08	12-2-09	0.87	0.14	0.71	0.16
541 (GF5D)	11[4]	12-3-09	***	0.87	0.12[5]	0.71	0.14[5]
542 (GF5X)	11[4]	12-29-08	12-2-09	1.49	0.14	0.80	0.16
542 (GF5X)	11[4]	12-3-09	***	1.49	0.12[5]	0.80	0.14[5]

1   Effective for all tests completed on or after this date.

2   *** = currently in effect.

3   Pooled s from matrix analysis.

4   Matrix n-size.

5   November 2009 Pooled s calculation based on additional data– reference oil n-size used= 540-36, 541-24, 542-33, GF5B-3 and GF5C-4.

Test	Parameter	s	Effective Dates	
			From	To
Sequence VIB	FEI1	0.18	8-25-98	***
	FEI2	0.17	8-25-98	***
Sequence VID	FEI1	0.14	4-22-09	12-2-09
	FEI2	0.16	4-22-09	12-2-09
	FEI1	0.12	12-3-09	***
	FEI2	0.14	12-3-09	***
Sequence VIII	TBWL	3.40	8-29-98	11-16-99
		5.28	11-17-99	2-5-02
		4.80	2-6-02	***
	10hr. Stripped Vis.	None	--	--
1M-PC	WTD	50.5	9-14-93	***
	TGF	16.1	9-14-93	***
1K	WDK	35.6	5-6-90	***
	TGF	15.7	5-6-90	***
	TLHC	1.1	5-6-90	***
	OC	None	--	--
1N	WDN	27.1	3-14-93	***
	TGF	14.6	3-14-93	***
	TLHC	0.9	3-14-93	***
	OC	None	--	--
1P	TGC	7.740	2-19-97	***
	TLC	13.150	2-19-97	***
	AOC	0.3238	2-19-97	***
	WDP	57.60	2-19-97	***
	EOTOC	0.5177	2-19-97	***
1R	WDR	29.0	7-1-01	***
	TGC	9.70	7-1-01	***
	TLC	7.84	7-1-01	***
	IOC	1.32	7-1-01	***
	EOTOC	1.35	7-1-01	***
C13	TGC	None	--	--
	TLC	None	--	--
	OCΔ	None	--	--
	R2TC	None	--	--
ISB	Camshaft Wear	None	--	--
	Tappet Wt. Loss	None	--	--
ISM	X-Head Wear	None	--	--
	OFDP	None	--	--
	Average Sludge	None	--	--
	Adj. Screw Wear	None	--	--
T-8	Vis. Inc. @ 3.8%	1.19	4-1-94	9-30-96
	Vis. Inc. @ 3.8%	0.93	10-1-96	1-31-99
	Vis. Inc. @ 3.8%	0.90	2-1-99	***